INFORMATION SHARING IN CONSTRUCTION SUPPLY CHAIN MANAGEMENT PERFORMANCE: A PRELIMINARY STUDY

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ABSTRACT

In the present competitive industrial and business environment, information becomes one of the most valuable assets to organisations, since information is anything that reduces uncertainty. The utilisation of information that flows within the organisation is an important process. Information that flows from one entity or functional area to another should be able to support the management in formulating strategy. Focusing on the information supply chain in isolation is a shortcoming, as most managers realise that information is needed from the whole supply chain in order to make a sound decision. Supply Chain Management (SCM) has been adopted in various industrial contexts, namely manufacturing, textiles, healthcare, and foods. In this paper, the focus is on the construction supply chain, which in Malaysia has been emphasised upon by the Malaysian government through the Construction Industry Development Board (CIDB) to accelerate its practices among the industry players. The important aspect to realise the implementation of SCM is regarding information sharing practices. This paper presents an overview of information flow in the organisation, information supply chain, and construction supply chain, in order to understand the basis to information sharing practices. A brief explanation is given on the methodology used in the research, and the paper concludes with some insight regarding information sharing practices in the construction supply chain.

Keywords: supply chain management, information sharing, Malaysian construction

INTRODUCTION

The Construction Industry Master Plan (CIMP) has been released by the Malaysian government through its construction arm, Construction Industry Development Board (CIDB), which details out the strategic approach to accelerate the development of the construction industry in Malaysia. The implementation of SCM in the Malaysian construction industry is one of the key thrusts of the CIMP, where all the key players along the construction supply chain should continuously improve all the processes along the supply chain starting from the suppliers, all the way to the client.

The SCM concept has been applied and proven successful empirically in the manufacturing sector, covering many industries including food, textile, and healthcare industries to name but a few. However, there were also some concerns raised over the applicability of such an approach in all the different industries. The variation of all the industries has perhaps caused doubt about the applicability of this concept. However, there are also efforts being made to explore its promising applicability in other viable sectors, such as the focus of this paper, the construction industry.

The utilisation of information that flows within the organisation is an important process. Information that flows from one entity or functional area to another should be able to support the management in formulating the strategy. Strategy development for every functional area within the internal supply chain plays a major role in determining the success of Construction Supply Chain Management (CSCM) development (Bechtel & Jayaram, 1997). Furthermore, organisations should be able to develop a strategy that enables all members within the supply chain to share information, work together, and formulate common objectives to maintain the competitiveness of individual organisation, and thus have a spill-over effect to the entire supply chain.

ORGANISATIONAL INFORMATION FLOW

The rapid development in technology, specifically information and communication technology, influences the changes (such as the technique or system) in a particular activity of the organisational strategy over the supply chain. For example, the use of technology shifts the production strategies, which reflect the effectiveness of the supply chain in terms of the reduction of the number of rework, rejected product, or waste. In addition, due to the advancement in technology, the market environment focuses more on customer's requirement, which requires the organisation to improve their flexibility in capturing information that flows from customers, to enhance the coordination of production processes in designing and producing products to comply with customer specifications (Albino, Pontrandolfo, & Scozzi, 2002). Therefore, changes or alignments in the organisational SCM are needed in order to face this situation and as a way to reduce the cost and improve delivery time by utilising the strategy that is developed based on the present environment (Feitzinger & Lee, 1997).

In the present competitive industrial and business environment, information becomes one of the most valuable assets to the organisations, as information is anything that reduces uncertainty. Davis (1993) found that the uncertainty that is generated in the network or supply chain (such as late deliveries, order cancellation, and machine breakdowns), are the real problems that are faced by the organisation. This finding is supported by Mason-Jones and Towill (1997) who revealed that reducing uncertainty is an issue in redesigning the supply chain in order to improve the effectiveness of information movement within the whole supply chain. In addition, companies also face challenges such as reducing information processing time, improving the value of information, and decreasing the costs of processing and distributing the information (Walsh & Koumpis, 1998).

Focusing the information supply chain in isolation is a shortcoming, as most managers realise that information is needed from the whole supply chain in order to make a sound decision (Sarkis & Sundarraj, 2000). As the backbone to an effective SCM, the flow of information should not only be from suppliers to customers but also bi-directionally (Bechtel & Jayaram, 1997). This situation corresponds with the information flow architecture shown in Figure 1, where information moves horizontally and vertically within the organisation.

Based on this architecture, there are three types of information flows within and between the supply chains (Hitomi, 1996). These are based on the levels of management, namely strategic, managerial, and operational levels. As shown in the figure, the strategic management information flows from the top management to every functional area to deliver information that is related to the organisation's vision, goals, and policies that should be implemented throughout an organisation. The information flow known as managerial information, contains instructions and procedures as well as objectives and policies of the functional areas. In addition, this information is used in developing functional strategy and assisting in the decision-making process.

In utilising the information that flows within and between organisations, management deals with three situations that are related to the degree of problems and the degree of decisions. The strategic management faces the high degree problem, which requires an unstructured decision making approach in order to solve it. For example while dealing with fluctuating demands from customers, the management requires the high use of information before making a decision in order to avoid the ineffective decisions.

This is contrary to the situation at the operational level, where the degree of problem is low and the approach to solve it is in a more structured manner. As an example, if the top management decides to push more products into the market, the problem is on how to produce more products based on the current production capacity. One decision that the production manager probably can decide is to increase the number of shifts.

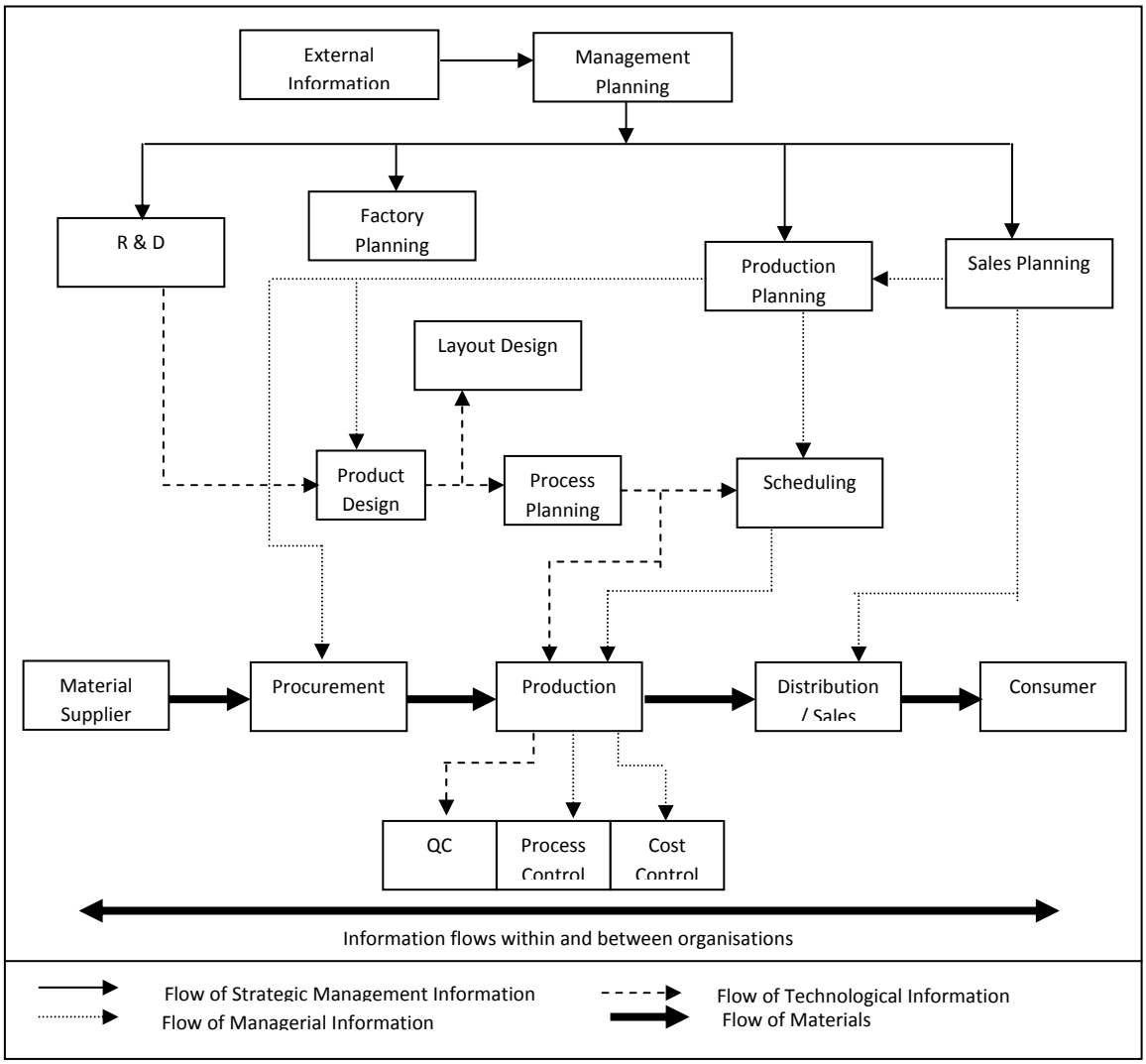

Figure 1: Organisation Information Flow (adapted from Hitomi, 1996)

In addition, this also reflects on the daily supply chain operations, where the decision from one organisation has an effect either to the upstream or downstream of the supply chain, and also influences the information that flows throughout the chain. Therefore, many organisations utilise an intelligent information system to support the management in making a decision not only to solve daily unstructured problems, but also in planning and designing the support systems such as performance measurement system, production facility management, and production planning and control (Meziane, Vadera, Kobbacy, & Proudlove, 2000).

Turban and Aronson (1998), and Mallach (2000) stressed that management needs a high quality of information that flows within the supply chain externally or internally, to enhance the effectiveness of decisions. Some information can be used to add some additional values to processes, decisions, or products purely by its correct usage. Furthermore, this decision should be reflected in improving customer service levels, lowering costs, and reducing delivery time in the whole network. This capability is needed

in order to make sure the information flows smoothly and is able to create and support supply chain collaboration. In addition with this environment, organisations can improve their respective relationships within the chain, which has led to the creation of not only products or services, but also the new marketing approaches and operations (Hoek, 1998).

INFORMATION SUPPLY CHAIN

Graham and Hardaker (2000) emphasised that in CSCM, information could reach beyond the boundary of an individual organisation in order for suppliers, OEMs, and customers to share the valuable information amongst them. In the competitive market, the competitiveness of organisations relies on how effectively the user can access and understand the information that flows in the supply chain. Parallel to this finding, Walsh and Koumpis (1998) earlier identified that organisations should emphasise on the importance of managing the information supply chain due to the need to use information in managing a business effectively and efficiently.

This argument is supported by Andel (1997), who stressed that the capability in managing the information supply chain effectively could determine the success or failure of organisations. Furthermore, information that flows within organisations also determines the smoothness of information flows across the chain. Many studies have shown that the capability of organisations in managing their information provides an opportunity for developing a good relationship among suppliers and customers in delivering a product or service.

Related to this situation, Mason-Jones and Towill (1997) described that implementing the strategy of information sharing among suppliers and customers could reduce the distortion in information that not only improves the overall speed of response, but also lessens the impact of demand magnification phenomena. In addition, Lummus and Vokurka (1999) suggested the necessary action that organisations needs to implement in capturing the information, determining how to share with other supply chain partners, and deciding on how to make the information improve their business decisions. This research shows the result on how information has become a critical factor to gaining competitive advantage through sharing the information and capability of supply chain members.

Yu, Yan, and Cheng (2001) stressed that the information that is shared among members can reduce uncertainties, such as delayed deliveries, order fluctuations, and specification errors, which are produced either by suppliers, OEMs, or customers. These uncertainties can affect the performance of supply chain members, due to an increase in operating and maintenance costs, late delivery, and stock overload. Lummus and Vokurka (1999) stressed that in order to respond to customer demand, management needs information from all entities in the chain to identify the current organisational position in order to make the entire supply chain a success. The capability in sharing and exchanging information is a core element in the information supply chain. Zhao, Xie, and Zhang (2002) revealed that among the benefits of implementing information sharing are an improvement in customer service levels and reduction of the total cost, which directly enhances the performance of the supply chain partnership. However, they also discovered that under certain conditions, such as low demand pattern and demand capacity, information sharing can have a bad impact on downstream members such as distributors and retailers, due to advance ordering from the retailers whilst the demand for the products is actually low. This phenomenon known as the “Bullwhip Effect”, and leads to cost increases, excess inventories, and profits reduction (Lee & Yang, 2000; Xu, Dong, & Evers, 2001).

Furthermore, Yu et al. (2001) found that the importance of information sharing could deliver benefits not only to OEMs but also to suppliers and customers in terms of improvement in inventory levels, reduction of costs, and the elimination of overload ordering. In collaborative supply chains, even though suppliers,

OEMs, and customers have different objectives, their goals can be the same where they do share common processes, such as planning, forecasting, and replenishment. In addition, the utilisation of information technology infrastructure can simplify the process in managing the information supply chain. Members of a supply chain can share and exchange information through the capability of networking such as the Internet and centralised databases.

CONSTRUCTION SUPPLY CHAIN MANAGEMENT

In the construction industry, especially in Malaysia, SCM has been considered by many as a viable solution to improving the reality of the industry (Benton & McHenry, 2009; O'Brien, Formoso, Vrijhoef, & London, 2010; Pryke, 2009; Oakland & Marosszeky, 2006), which is described as having problems in its structure that is particularly fragmented, leading to poor performance. Previously in the Malaysian construction sector, the outlook did not look bright, with lacklustre financial performance that stagnated between 2000 and 2007 with a recorded average growth of 0.7%, as compared to the GDP over the same duration of 5.46% (CIDB, 2007).

As a collective initiative, the Malaysian government, through its construction arm CIDB, has produced the Construction Industry Master Plan (CIMP) Malaysia 2006-2015 (CIDB, 2007), which was formulated by the collaborative efforts of the construction industry stakeholders who were concerned about the direction the construction industry was heading. The CIMP had detailed out the key problems facing this sector, which include inefficient and ineffective methods and practices; inability to attract and develop local workforce; difficulty in securing timely and adequate financing; and inability to provide total integrated solutions.

Therefore, in order to address and solve these issues, the CIMP has identified several key strategic thrusts, and the first strategic thrust, that is related directly or indirectly to SCM, is identified as, to "integrate the construction industry value chain to enhance productivity and efficiency" (CIDB, 2007, p.94). More detailed recommendations were also drawn out, which are to "consolidate the industry" and to "standardise and integrate administrative practices and procedures".

In order to follow the above recommendation and thus improve the industry, information sharing needs to be focused upon. This is because contrary to the conventional and adversarial form of relationships, effective SCM requires firms to seek close, long-term working relationships with partners and depend on one another for much of their business, and develop interactive relationships with partners who share information freely, who work together to solve common problems during the design of new products, who jointly plan for the future, and who make their success interdependent (Spekman, Kamauff, & Muhr, 1998; Theodorakioglou, Gotzamani, & Tsiolvas, 2006). Theodorakioglou et al. (2006) had identified six constructs of supplier relationship development, which are supplier policy, communication/information sharing, joint action of supplier/buyer, relationship handling, supplier support, and relationship quality.

The successful companies of today continue to grow in size and operations, and with the advent of globalisation, more companies are facing greater challenges in trying to conquer a larger share of the market. In the industrial sector, companies are moving away from concentrating on just their products to a more holistic approach whereby they shift their focus on the processes internal and external to their company. No longer are successful businesses looking to improve just themselves, but also improve their immediate partners upstream and downstream of their. This is where Supply Chain Management (SCM) has been touted as perhaps the next viable way of gaining this advantage.

Although defining SCM has been quite a challenge for the scholars, one of the popularly accepted definition for SCM would be according to the Council of Supply Chain Management Professionals (CSCMP, 2010), where SCM is defined as:

> Supply chain management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies.

SCM has been adopted in various industrial contexts as mentioned earlier. In the food industry, Mohtadi (2005) had revealed that information sharing increases the efficiency of players (retailers) because of better coordination of supplies and orders, but the level of sharing was dictated by the size of the chain, e.g. firms participating in larger chains tend to invest more in information and communication technologies in order to facilitate information sharing than the companies involved in smaller chains.

METHODOLOGY

Since this was an exploratory study, a mix-mode approach was used, which is using a combination of quantitative and qualitative approaches in order to investigate the phenomenon of information sharing in the desired construction context. Basically, this mix-mode approach consists of two phases, which are the inductive qualitative approach and the deductive quantitative approach. During the inductive phase, a phenomenon that is detected will be explored by performing qualitative data collection, which is then described and organised in a systematic way. The output from this process, a substantive theory can be produced, ready for verification and exploration. This theory will take the researcher back to the phenomenon, and the deductive cycle will then be commenced through an in-depth literature review to obtain the formal theory. This theory can then be proved or disproved by performing field or real world verification, which leads the focus back to the phenomenon when the researcher tries to make sense of the findings and perhaps may launch another inductive cycle as new data are observed.

The scope of the research was narrowed down further to the industrialised building system (IBS) industry involved in the construction of residential buildings, and companies that were registered as between G5 and G7 companies. Therefore, the population lists were obtained from several authoritative sources. The supplier and contractor lists were obtained from CIDB and the developer list was obtained from REHDA. However, the restrictions set by the narrowing of scope cannot be applied to the developer list, since it is not feasible to determine their status individually through personal contact.

Preliminary interview sessions were performed, by using a carefully crafted interview protocol, at several companies to indentify the problems and issues involved. A questionnaire was then developed by combining the initial findings with the results from the literature. A pilot study was performed to refine the questionnaire as well as the interview protocol for the main round of investigation.

Thus, for the main round of investigation, a total of 300 questionnaires were sent (the minimum sample size were calculated using an online application at http://www.raosoft.com/samplesize.html) out to various companies via post that were randomly selected, and a total of 20 interviews were performed at the various companies. The interview sessions were recorded, where allowed, and transcribed later. For the interviews where recording was not possible, extensive note-taking was performed while the interview was performed. From these transcriptions, the resulting data was processed using NVIVO software, where the transcriptions were labelled and themes were identified and coded. The codification revealed an initial picture of information sharing in the construction supply chain.

Information sharing in the context of the construction industry would be the way companies divulge their information with the players upstream and downstream relative to their company in the supply chain. In

the context of this research, various questions were asked in order to address and explore this issue. Several questions were presented to the respondent regarding this topic based on the preliminary interviews and previous literature, using a Likert-like scale of 1 (Low) to 4 (High). A total of 12 supply chain performance questions were also presented to the respondents, with a 1 (Low) to 4 (High) scale as well. The data obtained from this section was keyed-in the SPSS software, where it was used to run some initial statistical analysis.

RESULTS

From the analysis, it can be observed that most of the respondents were not ready to divulge information with their partners up and down the stream. This is because the highest ranked item (share supply chain information within the organisation) only had a mean of 2.90, and the lowest ranked item (have information technology system to communicate supply chain information with external parties) had a mean of 2.33. This meant that overall, the respondents were of the inclination to withhold information from other players in the supply chain. The rest of the items are presented in Table 1.

Table 1
Ranked means and standard deviation of information sharing items

Item	Mean	Std. Deviation
C2.3-share SC information within the organisation	2.90	.721
C2.4-use SC information for decision making	2.83	.727
C2.5-use SC information to plan the production/construction	2.81	.864
C2.6-have information technology system to communicate SC information within the organisation	2.56	.861
C2.2-share SC information with customer	2.49	.869
C2.1-share SC information with suppliers/contractors	2.47	.799
C2.7-have information technology system to communicate SC information with external parties	2.33	.887

Meanwhile, with regard to supply chain performance, the items of information sharing were analysed using Pearson correlation to see if there are any relationships between the information sharing factors with supply chain performance. The summary of the results is presented in Table 2 below.

From this, it can be observed that there were several items that were significantly correlated with the performance measures at the 99% significance level, which are ranked from highest to lowest as follows:

1. use SC information to plan the production/construction with cost performance (0.481),
2. use SC information for decision making with cost performance (0.449),
3. have information technology system to communicate SC information within the organisation with cost performance (0.415)
4. share SC information with suppliers/contractors with cost performance (0.414), and
5. share SC information with customer with flexibility performance (0.410).

Out of the five significant correlations listed above, the four most significant are related to cost performance, while the lowest ranked significant correlation was with flexibility performance. This relationship is said to be very important in the literature, whereby organisations that want to improve their

supply chain performance should focus upon improving their information sharing capabilities, especially, in the context of this study, using shared information to plan the construction with all the related parties, even from the very early stages (O'Brien et al., 2010; Pryke, 2009; Theodorakioglou et al., 2006).

Additionally, there were also less significant correlations at the 95% significance level, but significant nevertheless. These are ranked in descending order as follows:

1. share SC information with suppliers/contractors with flexibility performance (0.391),
2. share SC information within the organisation with cost performance (0.359), and
3. have information technology system to communicate SC information with external parties with cost performance (0.306).

Similar to the earlier 99% significant correlations, these weak correlations also exhibited relationships between the information sharing factors with flexibility and cost performance.

Table 2
Correlation between information sharing items with supply chain performance

		Performance			
Item		Quality	Flexibility	Timeliness	Cost
C2.1-share SC information with suppliers/contractors	Pearson Correlation	.260	.391*	.261	.414**
	Sig. (2-tailed)	.100	.011	.077	.006
C2.2-share SC information with customer	Pearson Correlation	.066	.410**	.119	.290
	Sig. (2-tailed)	.683	.008	.425	.062
C2.3-share SC information within the organisation	Pearson Correlation	-.045	.289	.050	.359*
	Sig. (2-tailed)	.781	.070	.741	.021
C2.4-use SC information for decision making	Pearson Correlation	.249	.195	.276	.449**
	Sig. (2-tailed)	.117	.222	.060	.003
C2.5-use SC information to plan the production/construction	Pearson Correlation	.090	.220	.271	.481**
	Sig. (2-tailed)	.577	.168	.065	.001
C2.6-have information technology system to communicate SC information within the organisation	Pearson Correlation	.132	.297	.205	.415**
	Sig. (2-tailed)	.417	.062	.171	.007
C2.7-have information technology system to communicate SC information with external parties	Pearson Correlation	.186	.166	.259	.306*
	Sig. (2-tailed)	.244	.300	.079	.049

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

CONCLUSION

From the preliminary study, it was found that information sharing in SCM does require further investigation because of its due potential that had been observed in other settings. In the Malaysian construction industry however, supply chain management, is still at a stage where there is plenty of room for improvement. Based on the preliminary findings, it was revealed that the players within the construction industry are still not open and trusting of their partners to the extent that they can openly share sensitive information in order to perform joint business and mutual manpower development.

It was observed that the players value quality and reliability of suppliers the most, but they are not ready to invest in the information technology structure to be able to take the communication and information sharing to another level, even though it is evident in the literature that collaborative practices are required.

Therefore, an exhaustive data collection should be continued to explore more the concept of information sharing in the Malaysian construction industry. The question of trust and honesty remains unexplored territory for those researchers brave enough to venture into it, since this was identified as a very sensitive area during the interviews. The questionnaire could be refined further, and thus perform more efficiently at collecting the data and reducing the ambiguity among respondents towards this study.

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